Constraints and perspectives for large-scale electricity production from sugarcane residues in Brazil

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The potential and constraints

Brazil is worldwide the largest sugar-cane producer. The production during the harvest season 1999-2000 was 315 million tons. About 20 million tons of sugar were produced jointly with 12.8 billion liters of alcohol in that season. Despite historically important, the sugar-cane activity became more relevant just after the creation of Brazilian Alcohol Program in middle 70s. Alcohol production is no longer as important as it was during the 70-80s and, consequently, the fleet of neat alcohol cars has steadily decreased during last 10 years. Sugar-cane industry has gradually become more flexible, shifting the production from sugar to alcohol and vice-versa, depending on the behavior of sugar international prices. Brazil is very competitive regarding sugar international trade but the ethanol market depends on the high taxes impose to gasoline.

Electricity production on cogeneration systems at Brazilian sugar-cane mills, based on bagasse, is as traditional as in many other countries. However, in 1999 electricity production from sugar-cane bagasse (4.1 TWh) contributed with less than 2 per cent of total electricity production in the country. Electricity is essentially produced for mill's self-consumption, being the amount of surplus electricity sold to the grid (about 40 MW) irrelevant in comparison with the installed capacity (approximately 1000 MW). On the other hand, electricity production from sugarcane residues has been presented for many years as an alternative of large potential.

Most of sugarcane production occurs in the Southeast region of the country (e.g., 63 per cent in the São Paulo State), that is also the most industrialized area. Sugarcane activity is coincident with the dry season, when hydropower plants can not operate with their full capacity (in Brazil more than 90 per cent of electricity generation is based on hydroelectricity). Particularly in 2001, due to an atypical drier summer, shortages in electricity supply have been foreseen for the months to come (winter season). Just based on conventional backpressure steam cogeneration cycles and using the bagasse already available, additional 2,000-3,000 MW could be added to the system. Additional advantages of this option could be identified on the following points:

- the required technology is commercially available in the country;
- there is a window opportunity due to the fact that most of existing boilers and steam turbines need replacement over next 10 years;
- a good degree of diversification could be reached by this economic activity, resulting in some level of cost reduction on ethanol production. It should be said, however, that the level of cost reduction that can be reached as function of small-scale electricity production is not enough to make ethanol competitive vis-à-vis gasoline;
- as a distributed resource, investments in electricity transport can be deferred;
- as a distributed resource, benefits of capacity decentralization and greater reliability are expected;
- plant's time of construction is relatively small;
- use of a renewable source of energy, with associated local, regional and global benefits.

In recent years, after restructuring of Brazilian electric sector, some regulatory measures have been adopted aiming at deploy electricity production from sugarcane residues. These measures include the definition of a premium tariff that could be applied for the electricity produced from renewables and the outlining of criteria for plant's qualifying. Theoretically, the status of qualified plant could be useful to get financial and fiscal benefits that, however, were not defined so far. Unfortunately, current picture is quite similar than the one observed years ago, mostly because these measures are not part of a well-established energy policy concerned with foster renewables in general, and biomass in particular.

Sugar-cane entrepreneurs have a large risk perception regarding surplus electricity production and, general sense, they cannot afford required investments. On the other hand, these entrepreneurs remain so conservative to accept joint ventures with private investors, limiting even more business possibilities. In addition, even after restructuring of Brazilian electric sector, private investors are skeptical enough to postpone their investments even in well proved technologies, such as natural gas combined cycle power plants.

The feasibility of surplus electricity production just during harvest season is restricted due to the short period of plant operation. Conversely, electricity production all over the year should be a better option, but technologies such as CEST (condensing-extracting steam turbines) cogeneration systems have not been considered. There is no technical constraint for the adoption of this technology and, furthermore, Brazilian industry is able to produce most of the equipment. CEST technology would be even more adequate because of further enlargement of biomass availability as function of compulsory green harvesting within the next 10 years. With the recovery of sugarcane trash (now just burned at the field before harvesting) the amount of biomass available at the mill site could be enlarged twice regarding current bagasse availability. The full potential of CEST technology in Brazilian sugarcane mills is estimated as 9,000 MW, being about 50% of this economically feasible.

Necessary changes and perspectives

Most of the problems of the Brazilian energy sector are concerned with the lack of clear and long run policies. Electricity production from sugarcane residues presents some potential advantages and, under some circumstances, could be competitive vis-à-vis conventional power generation alternatives even without given benefits. Brazil has not even started to explore the huge existing potential.

Best sites for medium to large-scale demonstration units should be identified and these projects should be technically and financially supported. The site definition should also include the evaluation of deferred investments on electricity transmission and distribution. Results of one or two well succeed demonstration projects should be powerful enough to change the environment, i.e., overcome the skepticism and induce changes on conservative behaviors.

Long-run warranties should be given to investors and, consequently, the development of a niche market is essential. Compulsory market for electricity produced from biomass is probably the best alternative as it seems Brazilian population is not ready for green marketing. Compulsory purchases by utilities – German and Danish models – or a model based on tradable certificates – like Dutch model or American RPS – are options that should be carefully analyzed.

Investments in technologies able to produce electricity in large-scale and all over the year should be prioritized. CEST technology is the unique option by the time being but developments of BIG-GT technology should be closed followed. In a short to medium run the use of fossil fuels to complement biomass should be instrumental from a technical, economic and a strategic point of view. Many power plants based on natural gas are expected to be built relatively close to the region where sugarcane plantations exist, but environmental drawbacks have postponed their licenses.

Finally, it should be remembered that carbon credits could foster electricity production from biomass and investors should pay close attention to possibilities associated with international initiatives.

All issues mentioned above are predicted to be analyzed in details in a project concerned with large-scale production of electricity from residues of sugarcane in the State of São Paulo. Preliminary results of this project should be available by September 2001.